Scientific motivation

The data sets – Selection process

Properties of the quasar candidates

Current / Future work

K–excess, an unexploited method for discovering red quasars

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Outline

Scientific motivation

The data sets – Selection process

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1 Scientific motivation

2 The data sets – Selection process

3 Properties of the quasar candidates

4 Current / Future work

QSO selection in optical imaging surveys: The UV excess method (UVX)

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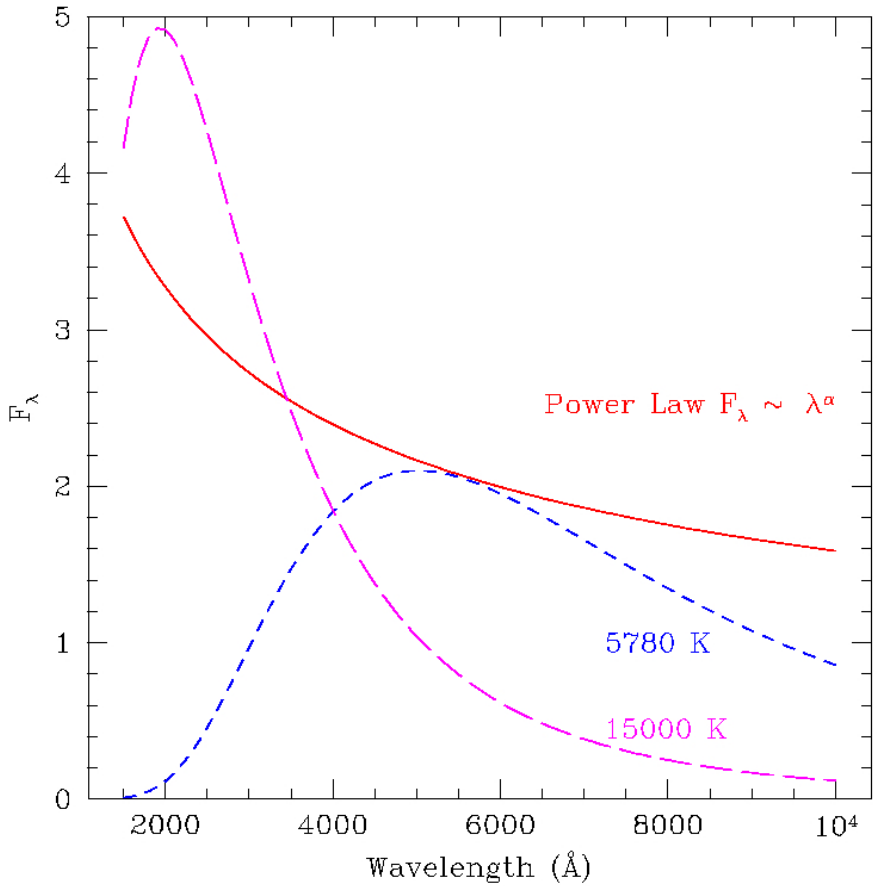
QSO SED: power law
Stellar SED: convex $\Rightarrow$

Quasars show UV flux excess $\Rightarrow$

In $(U-B)$ vs $(B-V)$ plane quasars occupy separate region!



The UVX method (2)

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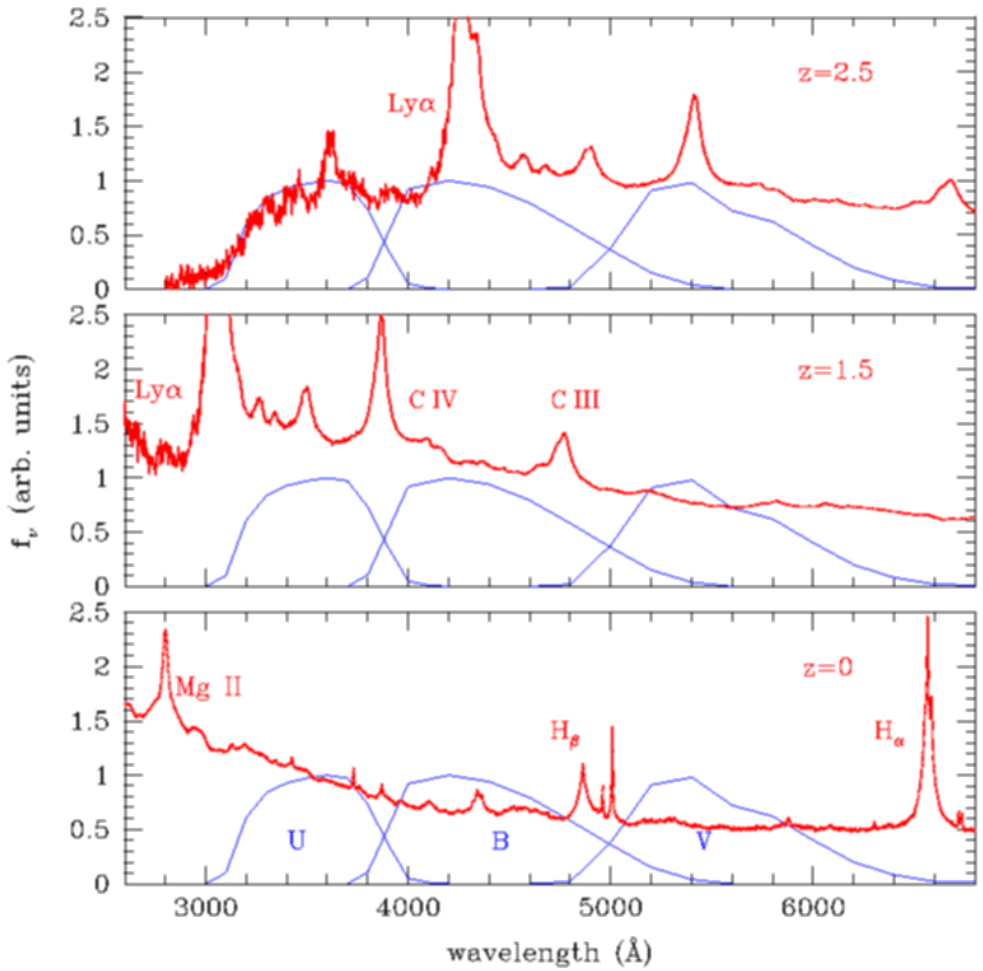

(QSO spectrum: Vanden Berk et al. AJ 2001)

Selection biases

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UVX:

- For $z > 2.2$ method fails
- Favors selection of optically (not IR) bright QSOs

The "Universal law" of surveys

Each survey picks objects respecting its selection criteria $\Rightarrow$

objects violating these criteria are NOT selected!! $\Rightarrow$

`Bias-free surveys don't exist`

Red & Reddened Quasars

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Red & Reddened Quasars

- Dust makes QSOs look redder (“reddened" quasars)
  - Projection effects $\Rightarrow$ obscuration (Type–II AGN)
  - Ly-α clouds $\Rightarrow$ extinction
- Intrinsically Red QSOs

Do we miss a red / reddened QSO population?

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Missed QSO population?

`Missed QSOs because of selection effects??`

Webster et al. (Nat. 1995), Francis et al (PASA 2000)

Benn et al. (MNRAS 1998), Richards et al. (AJ 2003)

Warren, Hewett & Foltz (MNRAS 2000): KX

- Based on IR colors, possible to detect “red" quasars
- K–band plays key role in selection
- KX: infrared analog of UVX

Implementing the KX–method (1)

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XMM–LSS survey (Pierre et al. 2004, JCAP)

Step 1: Perform quasar selection

Select quasar candidates using IR colors & morphology

- R, z'–band data, 4 m tel., CTIO
- K_s–band data, 2.5 m tel., Las Campanas

Step 2:Multi-λ properties of QSO candidates

- 2dF spectra
- $u^* g' r' i' z'$ data, CFHT
- XMM–Newton: X–ray data ([0.5–2] & [2–10] keV)
- Spitzer – SWIRE survey (IRAC 3.6, 4.5, 5.8, 8 and MPIS 24 μm)

Properties of the $Rz'K_s$ matched catalog

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Catalog matching:

- Independent reduction of Rz' & K_s data
- Catalogs extracted (SExtractor, Bertin 1996), correlated using K_s `as a reference`

Filter	Frames	Astr. pres.	Phot. pres.	Mag limit
R	190	$0.3''$	0.02	23.5
z'	190	$0.3''$	0.02	22.0
K_s	200	$0.5''$	0.07	18.0

Selection of the quasar candidates

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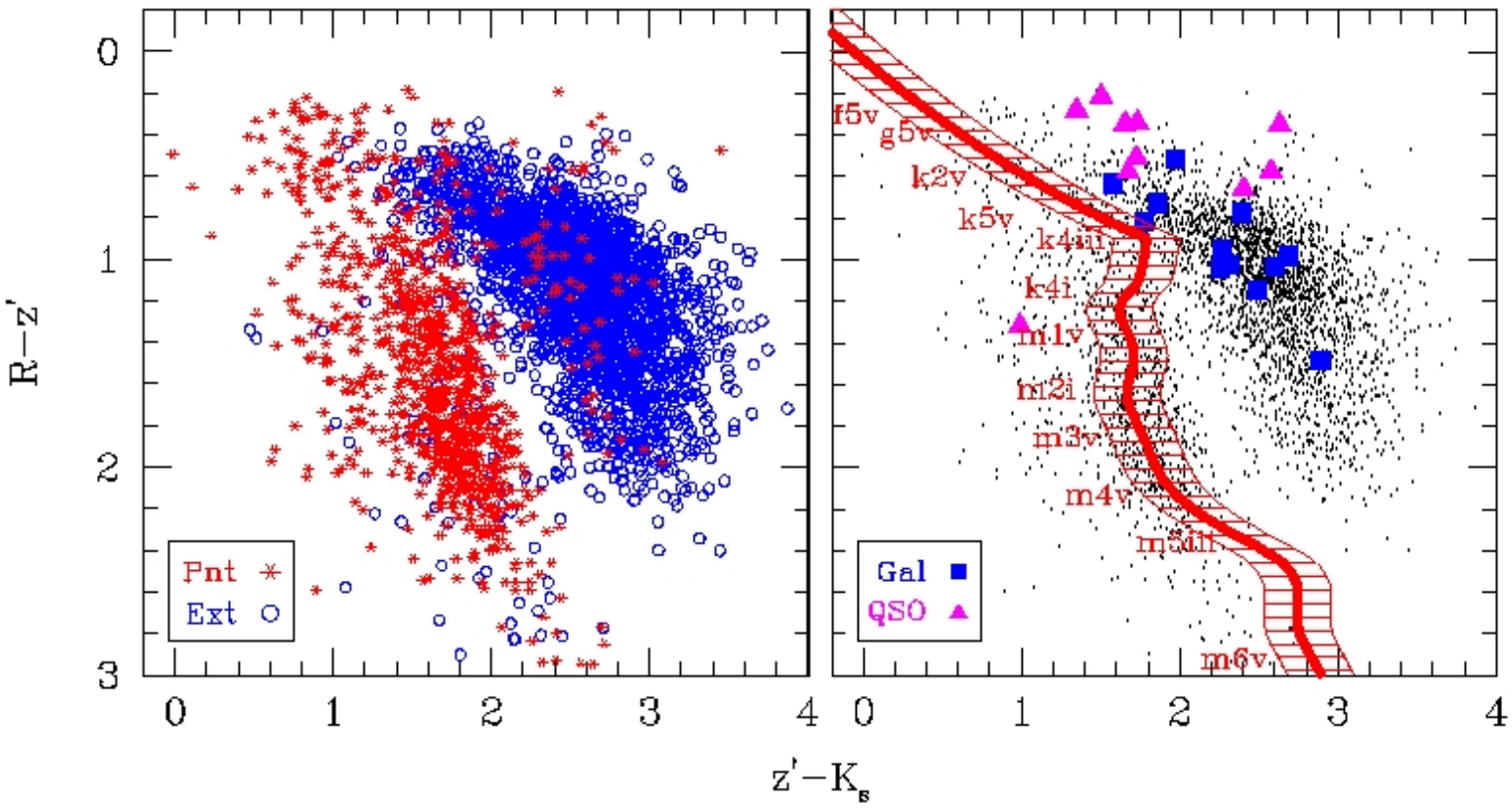

Stellar spectra: Pickles 1998

IR colors of the quasar candidates

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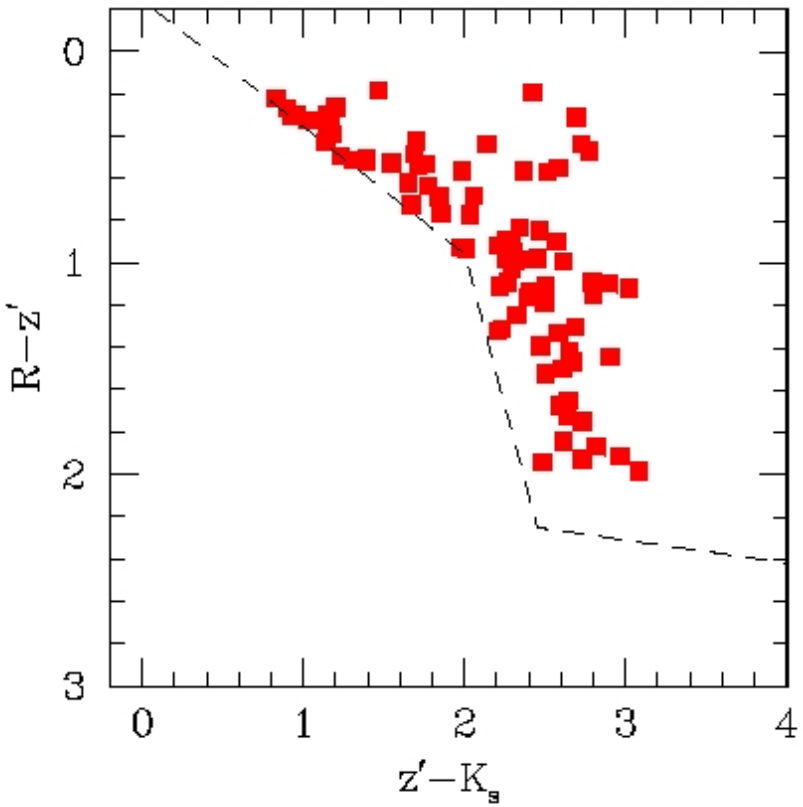
QSO candidates:

point–like morphology
galaxy–like colors

85 sources



Reconstructing the observational SEDs

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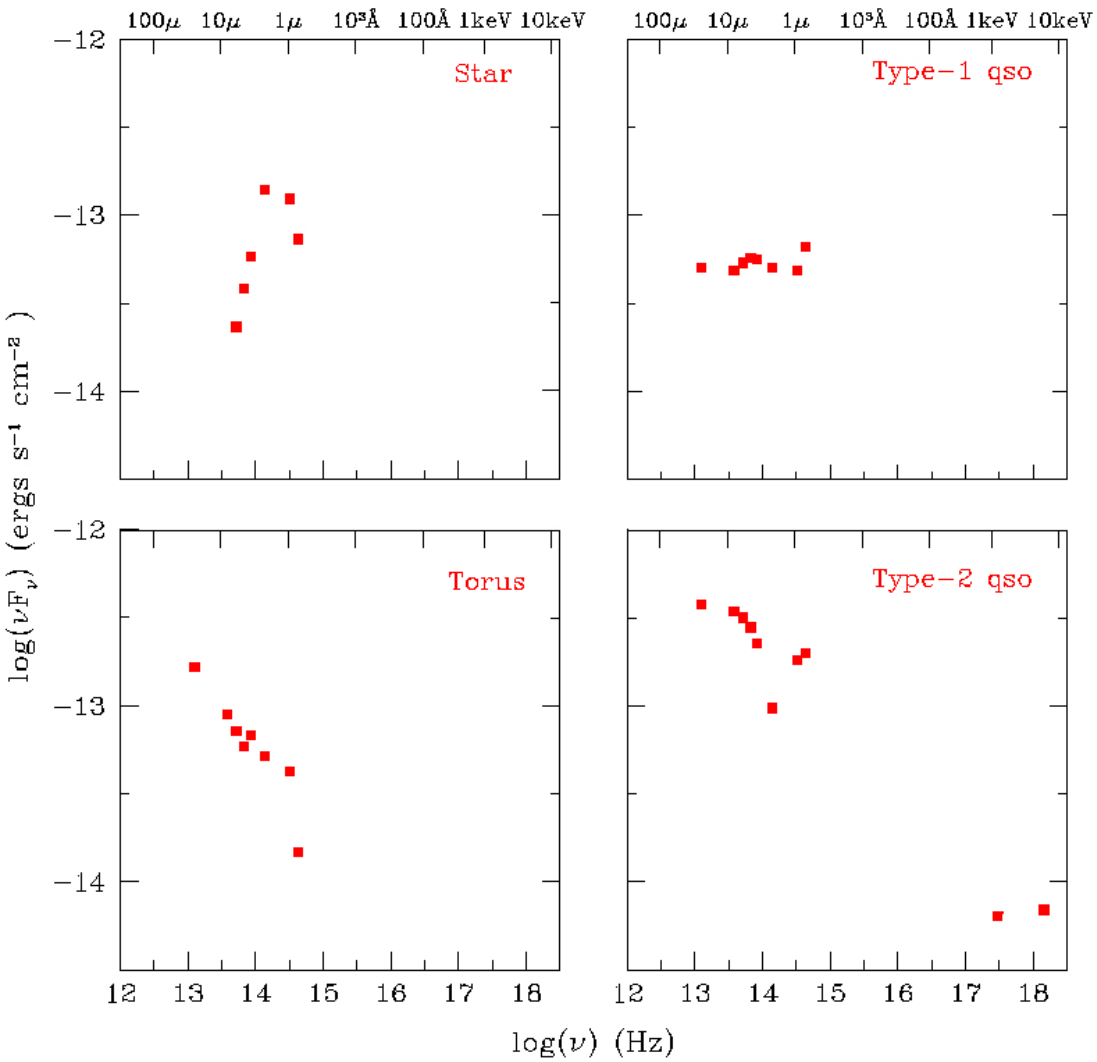

Evaluating the KX

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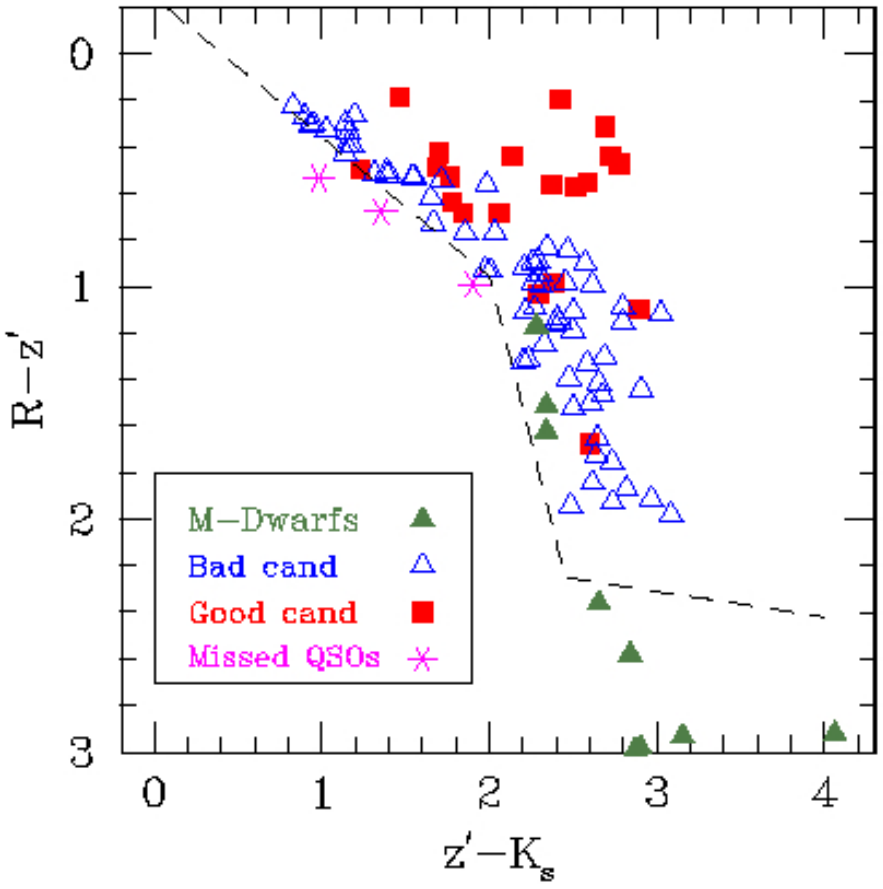
QSOs: 21

Contamin. Rate: 75%

Missed QSOs: 3

Success Rate: 85%



Stellar photometry:
Dahn et al. AJ 2002

Current/ Future work

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Current

- Evaluate method: Compare KX, IR & optically-selected quasar candidate samples
- Photometric redshifts: Test existing QSO templates

Future

Spectroscopic verification (CTIO proposal, March 2006)

- Characterize contaminants
- Measure z $\Rightarrow$ reconstruct `rest-frame` SED
  $\Rightarrow$ Model effect of dust on QSOs